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Quality of Fixed Prosthodontic Restorations and Periapical Status in A Selected Yemeni Population: Retrospective Study

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Abstract: *This study was aimed to determine the prevalence of faulty crown restorations and its relationship with incidence of periapical lesion in a selected Yemeni population. We assessed a database of digital panoramic radiographs from 455 patients. The final sample consisted of 221 radiographs with 620 dental restorative teeth with ceramic crowns. The quality of crown restorations and periapical status were reviewed by checking the post-treatment radiographs. The Chi-squared statistic was used for statistical evaluation of the results. The Spearman's correlation was utilized to assess associations among the studied parameters.*
The total number of crown restorations was 620, with the predominance of maxillary teeth 325 (52.4%). On the basis of tooth location as anterior or posterior, the predominance crown restorations were in posterior teeth 399 (64.4%). The most commonly restored teeth with crown were maxillary anterior 141 (22.8%), followed by both mandibular premolars and molars 108 (17.4%). Statistically significant differences were observed between the tooth group and adequacies of the restored teeth with crowns or the tooth group and periodontal status of the restored teeth with crowns ($p < 0.05$). The technical quality of crown restorations performed by general dental practitioners was poor. Therefore, there is a need to carry out continuing dental education programmes for Yemeni dental practitioners to update their knowledge about their dental practice.
Keywords : *Dental practitioner, Crown Restoration, Preapical Lesion, Yemen.*

I. Introduction

The goal of all prosthetic treatment is to get a sufficient functional and esthetical oral status. Successful treatment outcome following prosthetic treatment relies on healthy hard tissues but also on healthy soft tissues. Side effects as a result of the treatment may arise during the prosthetic rehabilitation, for example because of the preparation and its location [1]. Preparation types may differ in a number of ways, due to factors related to type of tooth, clinical crown height and position, tooth vitality, the degree of remaining tooth substance and specific aesthetic needs. Therefore, acceptable crown contours could offer protection of gingival margins, permit cleansing action of the musculature and facilitate the access for oral hygiene [2]. The success of a dental prosthesis, however, is only accomplished if the restoration residues in place over time and without causing disease [3-6]. The huge majority of studies, however, concentrate on different aspects of the relationship between dental materials, surface characteristics, adaptation, etc., thus providing guidelines for the dental practitioners [7-9].

Evidence from different studies points to a very close relationship between the periodontium and crowns and bridges. Insertion of fixed dental prosthesis may affect the periodontal conditions, the risk of incidence caries and the amount of stress on natural teeth [10]. In daily practice, overhanging margins of dental restorations present a regularly observed problem [11, 12] which may considerably interfere with the maintenance of gingival and periodontal health [13]. It is now generally accepted that overhanging restorations promote gingivitis by promoting the local accumulation of bacterial plaque rather than resulting in mechanical irritation [14]. Caries is one of the most common reasons for tooth loss worldwide [15-17]. Caries and/or loss of the retention have been reported to be the primary cause of failures of fixed prostheses [18]. Early and more extended adherence of bacteria on restoration margins has been found in patients presenting with high caries susceptibility [19]. Prosthetic restoration margins present with an increased risk compared to natural tooth surfaces for caries occurrence, even when the prostheses have acceptable fit [20].

A developing economy like Yemen would not have sufficient number of prosthodontist for the population in the foreseeable future; hence reliance would continue to be on general dentists by large segments of the population. Additionally, no published data are available in Yemen on the prevalence of periapical lesion and incidence of secondary caries related to the quality of dental crown restorations performed by general dental practitioners. Considering the mentioned issues and for the importance of having accurate statistics concerning the incidence of overhanging artificial crown and secondary caries and its relationships with periapical lesion, therefore this area was selected as a theme of the current study. The present study aimed to determine the

prevalence faulty crown restorations and its relationship with incidence of periapical lesion in a selected Yemeni population performed by general dental practitioners.

II. Materials and Methods

A retrospective review of digital panoramic radiographs of all patients seen at the Dental Health Center in Sana'a, Yemen 2012 and 2015 was undertaken. This study was approved by the Medical Ethics Committee of Faculty of Dentistry, Thamar University (Ethics No.: 2015/006). We assessed a database of digital panoramic radiographs from 455 patients. The final sample consisted of 221 radiographs with 620 dental restorative teeth with ceramic crowns. The target sample was dental crown restorations for natural teeth without any pervious root canal therapy. The missing crown restorations from abutment were also taken into consideration. To be considered for the current study, the digital panoramic radiographs images had good quality. However, those radiographic images presenting deformations were excluded from this study.

The periapical health and the quality of crown restorations were reviewed by checking the post-treatment radiographs. On radiographic examination, any radiolucency next to crown restorations was considered as the secondary caries. Overhanging margins were recorded on mesial or distal surface, and if the radiograph image showed a step or ledge extending beyond the normal smooth profile of the tooth, or a "beveled" appearance at the base of a proximal crown, it was attributed to overhang margin present in a concavity on the surface of the tooth. The periapical condition was scored according to the criteria listed in Table 1. The relation of periapical condition and crown restorations adequacy to tooth position (anterior/posterior, maxilla/mandible) was also assessed.

All radiographs were taken by the same operator using a panoramic digital radiography device (Tomography X-ray System Model Pax-Flex 3D Power Input: AC 100-120). All radiographs were reviewed by one dental surgeon. Before the evaluation, the observers participated in calibration training, which consisted of 50 randomly selected panoramic radiographs.

The analysis of the data was performed using SPSS 21.0 for Windows (SPSS Inc., Chicago, IL, USA). The Chi-squared statistic was used for statistical evaluation of the results. The Spearman's correlation was utilized to assess associations among the studied parameters.

III. Results

The total number of crown restorations was 620, with the predominance of maxillary teeth 325 (52.4%). On the basis of tooth location as anterior or posterior, the predominance crown restorations were in posterior teeth 399 (64.4%). The most commonly restored teeth with crown were maxillary anterior 141 (22.8%), followed by both mandibular premolars and molars 108 (17.4%).

Table 1: Criteria for evaluation used in this study

Parameters	**Criteria**	**Definition**
Condition of crown restoration		
	Acceptable	No any radiolucency at finishing line between tooth structure and crown restoration
	Unacceptable	Any crown restoration with detectable radiographic signs of overhangs, open margins, or recurrent caries.
	Missing	Tooth without crown restoration
Periapical status		
Healthy periodontal ligament	If the periodontal ligament was intact with no signs of periapical pathosis	
Apical periodontitis	If the widening of the apical part of the periodontal ligament was not exceeding two times the width of the lateral periodontal ligament space, teeth were categorized as having widening of the periodontal ligament	
Apical periodontitis	If the periapical radiolucency in connection with the apical part of the tooth exceeding at least two times the width of the lateral part of the periodontal ligament, such teeth were categorized as having obvious periapical radiolucency	

The location of crown restoration (maxilla/mandible, anterior/posterior) and adequacy of the restoration showed in Table 2. There was no statistically significant differences were noticed between the crown restoration adequacy of maxillary and mandibular teeth ($p > 0.05$). However, statistically significant differences were observed between the periodontal status of maxillary and mandibular restored teeth ($p < 0.05$). Additionally, dependence was also recognized between the tooth position (anterior/posterior) and adequacy of the restoration ($p > 0.05$). Furthermore, statistically significant differences were detected between the periodontal status of anterior and posterior restored teeth with crown ($p < 0.05$).

Table 2: Crown restorations and periodontal status of specimens by tooth location (anterior/posterior, maxilla/mandible)

Tooth Group	Total	*Condition of crown restoration*			*Periodontal status*		
		Missing	Acceptable	Unacceptable	Normal	Widening of PDL	Apical lesion
Anterior teeth	221 (35.6%)	2(.3%)	162 (26.1%)*	57 (9.2%)	149(24.0%)	67 (10.8%)†	5(.8%)†
Posterior teeth	399 (64.4%)	14(2.3%)	190 (30.6%)	195 (31.5%)	151 (24.4%)	228 (36.8%)	20 (3.2%)
Total	620 (100%)	16(2.6%)	352 (56.8%)	252 (40.6%)	300 (48.4%)	295 (47.6%)	25 (4.0%)
Maxillary teeth	325 (52.4%)	6(1.0%)	184 (29.7%)*	135 (21.8%)	169(27.3%)	154(24.8%)†	2(.3%)†
Mandibular teeth	295 (47.6%)	10(1.6%)	168 (27.1%)	117 (18.9%)	131(21.1%)	141(22.7%)	23(3.7%)
Total	620 (100%)	16(2.6%)	352 (56.8%)	252 (40.6%)	300(48.4%)	295(47.6%)	25(4.0%)
**No statistically significant difference ($P > 0.05$) between the crown restoration adequacy of maxillary and mandibular teeth.*							
† Statistically significant difference ($P < 0.05$) between the periodontal status of maxillary and mandibular teeth.							
**Statistically significant difference ($P < 0.05$) between the crown restoration adequacy of anterior and posterior teeth.*							
† Statistically significant difference ($P < 0.05$) between the periodontal status of anterior and posterior teeth.							

The association location (maxilla/mandible, anterior/posterior) and quality of crown restorations and incidence periapical lesion showed in Tables 3 and 4. Compared to maxillary restored teeth, the percentage of incidence of the widening of periodontal ligament (PDL) and periapical lesion was significantly greater in mandibular restored teeth ($p < 0.05$). However, no correlation was established between the tooth position (maxilla/mandible) and adequacy of the restorations ($p > 0.05$). Relationship anterior to posterior restored teeth, there were significant differences between adequacies of the restorations of anterior and posterior teeth restored with crowns or the periodontal status of the anterior to posterior restored teeth with crowns ($p < 0.05$).

Table 3: Spearman's correlation representing interrelationships among variables (maxilla/mandible)

Variables	Tooth position	Condition of crown restoration	Periapical status
Tooth position	---	-.027	.108*)
Condition of crown restoration	-.027	---	.663**
**Correlation is significant at the 0.05 level (2-tailed).*			
***Correlation is significant at the 0.01 level (2-tailed).*			

Table 4: Spearman's correlation representing interrelationships among variables (anterior/posterior)

Variables	Tooth position	Condition of crown restoration	Periapical status
Tooth position	---	.201**	.280**
Condition of crown restoration	.201**	---	.663**

**Correlation is significant at the 0.05 level (2-tailed).*

***Correlation is significant at the 0.01 level (2-tailed).*

Table 5 presents the crown restorations and periodontal status according to tooth group. The percentage of restored teeth with adequate crowns was 352 (56.9%). The highest percentage of restored teeth with adequate crown was observed in maxillary anterior 100 (16.2%). The overall percentage of restored teeth with adequate normal periodontal condition was 300 (48.5%), with the best results achieved in maxillary anterior 95 (15.3%).

Table 5: Crown restoration and periodontal status of specimens by tooth group

Tooth Group		Total	*Condition of crown restoration*			*Periodontal status*		
			Missing	Acceptable	Unacceptable	Normal	Widening of PDL	Apical lesion
Maxilla	Anterior	141(22.8%)	2(.3%)	100(16.2%)	39 (6.3%)	95 (15.3%)	45(7.3%)	1(.2%)
	Premolar	105(17.0%)	1(.2%)	42(6.8%)	62 (10.0%)	41(6.6%)	63(10.2%)	1(.2%)
	Molar	78(12.6%)	3(.5%)	42(6.8%)	33(5.3%)	33(5.3%)	45(7.3%)	0(.0%)
Mandible	Anterior	79(12.8%)	0(.0%)	62(10.0%)	17(2.7%)	54 (8.7%)	21(3.4%)	4(.6%)
	Premolar	108(17.4%)	1(.2%)	54(8.7%)	53(8.6%)	40(6.5%)	61(9.9%)	7(1.1%)
	Molar	108(17.4%)	9(1.5%)	52(8.4%)	47(7.6%)	37(6.0%)	59(9.5%)	12(1.9%)
Total		619(100%)	16(2.6%)	352(56.9%)	251(40.5%)	300(48.5%)	294(47.5%)	25(4.0%)

Table 6 shows the correlation between the quality of crown restorations and the periodontal status according to tooth group. Statistically significant differences were observed between the tooth group and adequacies of the restored teeth with crowns or the tooth group and periodontal status of the restored teeth with crowns ($p < 0.05$).

Table 6: Spearman's correlation representing interrelationships among variables by tooth group.

Variables	Tooth	Condition of crown restoration	Periapical status
Tooth	---	.083*	.262**
Condition of crown restoration	.083*	---	.592**
**Correlation is significant at the 0.05 level (2-tailed).*			
***Correlation is significant at the 0.01 level (2-tailed).*			

IV. Discussion

Dental caries and periodontal diseases have been historically considered the most important global oral health problems. The dental restoration is considered as risk factor for incidence the secondary caries and periodontal diseases. Therefore, the present retrospective study assessed the the quality of restored sound teeth with ceramic crowns and its relationship with periodontal conditions by utilizing digital panoramic radiographs. The negative factor of this study is that the data analysed are restricted to available information and thus may suffer from preconception [21]. However, the most important advantage of this method is the comprehensive sample size [22].

Fundamentally, restoration contour has been designated as extremely important to the preservation of periodontal health [23]. Proper contour lets access for hygiene, has the features to create the desired gingival form, and has an agreeable visual tooth contour in aesthetic areas. However, overcontour may have negative influence on periodontium since it increases plaque retention [24, 25]. Thus, restorative overhang is considered as a contributing factor of periodontal diseases. Many study stated that restorative defects can obstacle brushing of the teeth resulting to aggregate the plaque accumulation which potentiates gingival inflammation and worsen the periodontal status [26-28]. The findings of the current study are in agreement with pervious study that stated that overhang of the restoration considered as risk factor for periodontal disease [24-28].

In this study, the unacceptable restorations 251 (40.5%) and missing of the restorations 16 (2.6%) which was correlated with the incidence of the widening of PDL 294 (47.5%) and periapical lesion 25 (4.0%). This may be due to that placement of slightly overhanging filling margins was shown to result in a change of the subgingival microbiota adjacent to the subgingival restoration, favoring the colonization of gram-negative, strictly anaerobic rods [14]. Other possible reason is occurrence any defect during preparation for restoration or may be due to the dental cement for crown restoration dissolve leaving gap between the finishing line and the restoration resulting to aggregate the plaque accumulation which potentiates colonization the bacteria. Additionally, imperfect placement of the preparation of the tooth surface increases the risk of periodontal pathology installation. The existence of poorly processed or irregular margins greatly increases the size of the margins and reduces adaptation [29]. These potential environmental differences may have an effect on caries susceptibility of abutment teeth with subgingival prosthetic margin. Therefore, tooth preparation procedures must be performed carefully to avoid any damage that may arise and to preserve periodontal health. Furthermore, a preparation must ensure retention and stability of prosthetic reconstruction so the marginal adaptation will be adequate, with enough space for the restorative material and the fixing material (cement). Furthermore, as a functional unit, the tooth and its supporting structures bear the brunt of occlusal forces on the crown. In response to occlusal forces, the attachment apparatus may experience tissue changes, including injury, repair and adaptive remodeling of the periodontium. This may finally lead to widening of PDL and periapical lesion.

On the basis of tooth location as anterior or posterior, for anterior teeth the unacceptable restorations 57 (9.2%) and missing of the restorations 2(.3%) which was associated with incidence of the widening of PDL 67 (10.8%) and periapical lesion 5(.8%). However in posterior teeth, the unacceptable restorations 195 (31.5%) and missing of the restorations 14(2.3%) which was correlated with incidence of the widening of PDL 228 (36.8%) and periapical lesion 20 (3.2%). This due to that amount of the occlusal forces in the posterior teeth is higher than anterior teeth. Additionally, the patients have accessibility for cleaning and maintenance their good oral hygiene in anterior than posterior teeth.

There are rare reports on the difference between the technical quality of restored sound teeth with ceramic crowns and its relationship with periodontal conditions of maxillary or mandibular teeth. Possible reasons for the poor quality of crown restoration in mandibular teeth are not known even though the small size of this sample is a limitation in assessing the clinical significance. Larger sized surveys would hopefully explain this issue further.

V. Conclusion

For prosthodontics, periodontal health and quality of crown restorations play an important role on the longevity of restorations. On the other hand, defective prostheses may contribute to progression of periodontal diseases and incidence of secondary dental caries. We believe that improved undergraduate training, better equipment, higher professional standards and better technique would improve the quality of crown restorations.

Moreover, there is a need to carry out continuing dental education programmes for Yemeni dental practitioners to update their knowledge about their dental practice.

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